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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/661,666	09/14/00	QIAO J	5298-04100/P

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EXAMINER

PHAM, T

ART UNIT

PAPER NUMBER

2813

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DATE MAILED: 09/26/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/661,666

Applicant(s)

QIAO ET AL.

Examiner

Thanhha Pham

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 January 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

1. Claims 1-16, and 18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 1,

it is not clear where a dielectric layer is located for forming a semiconductor device.

With respect to claim 5,

- a. It is not clear where “an adjacent gate structure” comes from and is located.

To have the patent weight, limitation “an adjacent gate structure” should be positively cited in the claim as a part of a process step. What happen if a semiconductor device does not have an adjacent gate structure?

With respect to claim 11,

It is not clear where “said dielectric layer” is formed

With respect to claim 12,

It is not clear where “a dielectric layer material: silicon nitride selectivity” comes from and where “a dielectric layer material” & “silicon nitride” are located. A patent weight of the claimed selectivity value could not be given unless limitation of “silicon nitride” is positively

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cited in the claim as a part of a process step – patent weight of “a dielectric layer material: silicon nitride selectivity” value can not be given when forming a semiconductor device that does not have silicon nitride. In addition, it is not clear that “a dielectric layer material” as cited in claim 12 line is the material of the dielectric layer as cited in claim 1 or not.

With respect to claim 13,

It is not clear where “a dielectric layer material: silicon oxide selectivity” comes from and where “a dielectric layer material” and “silicon oxide” are located. A patent weight of the claimed selectivity value could not be given unless limitation of “silicon oxide” is positively cited in the claim as a part of a process step – patent weight can not be given when forming a semiconductor device that does not have silicon oxide. In addition, it is not clear that “a dielectric layer material” as cited in claim 13 is the material of the dielectric layer as cited in claim 1 or not.

With respect to claim 18,

It is not clear where “silicon nitride” and “silicon oxide” come from and are located at. A patent weight of “the first etch chemistry is selective to silicon nitride” and “the second etch chemistry is selective to silicon dioxide” could not be given unless limitations “silicon nitride” and “silicon dioxide” are not positively cited as a part of a process step – the patent weight can not be given when forming a semiconductor device that does not have silicon nitride and/or silicon dioxide..

Moreover, it is not clear that “the first etch chemistry is selective to silicon nitride” means that the first etch chemistry is selected to etch silicon nitride or the first etch chemistry is selected to etch the first portion of the dielectric layer while does not etch the silicon nitride.

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Similarly, it is not clear that "the second etch chemistry is selective to silicon dioxide" means that the second etch chemistry is selected to etch silicon dioxide or the second etch chemistry is selected to etch the second portion of the dielectric layer while does not etch the silicon dioxide.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

3. Claims 1-5, 8, 10-13, 15, and 17-18, as being best understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Flanner et al [US 5,783,496].

Flanner et al, figs 2-5 and col 1-7, discloses the claimed method of forming a contact hole in a semiconductor device comprising steps:

depositing a dielectric layer upon first and second gate laterally spaced gate structures (28, 30, fig 2) on a semiconductor layer (22) comprising isolation regions (24,26);

etching a first portion of the dielectric layer with a first etch chemistry; and

etching a second portion of the dielectric layer with a second etch chemistry different from the first etch chemistry, wherein a thickness of the second portion of the dielectric layer is greater than approximately one half of a height of the first and second gate structures.

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4. Claims 1-5, 8,10-13, 15, 17-18, as being best understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Tsai et al [US 5,728,619].

Tsai et al, figs 1-9 and col 1-15, discloses the claimed for forming an opening in a semiconductor device comprising steps:

depositing a substantially continuous dielectric layer (24, fig 2) upon first and second gate laterally spaced gate structures on a semiconductor layer comprising isolation regions;

etching a first portion of the substantially continuous dielectric layer with a first etch chemistry (fig 3); and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrogen-containing compound (CHF_3 , fig 4) wherein a thickness of the second portion of the substantially continuous dielectric layer is greater than approximately one half of a height of the first and second gate structures.

5. Claims 1-2,4,6-8,10-13,15-16, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Yang et al [US 6,274,481].

Yang et al, figs 1's-3's and col 1-5, discloses the claimed for forming a self-align contact in a semiconductor device comprising steps:

depositing a substantially continuous dielectric layer (50, 60, fig 2D) upon first and second gate laterally spaced gate structure on a semiconductor layer comprising isolation regions;

etching a first portion of the substantially continuous dielectric layer with a first etch chemistry substantially free of hydrogen ($\text{C}_4\text{F}_8/\text{CO}$) to expose a sidewall spacer of said gate structure; and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrofluorocarbon (CHF₃) to expose the semiconductor layer under said substantially continuous dielectric layer.

[see figs 2D-2H and particularly col 3 lines 1-28 for details].

6. Claims 1-5, 8-13 are rejected under 35 U.S.C. 102(b) as being anticipated by Nulty [US 5,562,801].

Nulty, figs 1-20 and col 1-15, discloses the claimed for forming a a semiconductor device comprising steps:

depositing a substantially continuous dielectric layer (1501, fig 15) in contact with sidewall spacers (1502) of a gate structure (1504) and a semiconductor layer (1500) comprising isolation regions (1503)

etching a first portion of the substantially continuous dielectric layer with a first etch chemistry substantially (fig 16, col 12 lines 6-29); and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrogen-containing compound (C₂H₂F₄/CHF₃, fig 17).

7. Claims 1-8, 11-14, 15-19, and 20, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by DeBoer et al [US 6,258,729].

DeBoer et al, figs 1-5's and col 1-15, discloses the claimed for forming a self-align contact in a semiconductor device comprising steps:

depositing a substantially continuous dielectric layer (141, e.g. F-TEOS, fig 4A) upon first and second gate laterally spaced gate structure on a semiconductor layer comprising isolation regions;

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etching a first portion of the substantially continuous dielectric layer with a first etch chemistry substantially free of hydrogen (figs 4A-B, fluorocarbon, col 12 lines 10-34, col 10 lines 33-48) to expose a sidewall spacer of said gate structure; and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrogen-containing compound (figs 4B-C, col 12 lines 48-51, col 11 lines 17-34) to expose the semiconductor layer under said substantially continuous dielectric layer.

8. Claims 1-6, 8, 11-13, 15, 17-18, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Wang et al [US 6,074,959].

Wang et al, figs 1-5 col 1-16, discloses the claimed method of forming an opening in a semiconductor device comprising steps of:

depositing a substantially continuous dielectric layer (24, fig 1) upon first and second gate laterally spaced gate structures (10,12) on a semiconductor layer (14) comprising isolation regions (18);

etching a first portion of the substantially continuous dielectric layer with a first etch chemistry substantially free of hydrogen (C_3F_6); and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrogen compound ($C_3H_2F_6$) to expose the semiconductor layer under said substantially continuous dielectric layer.

9. Claims 1-5, 8, 11-13, 15-18, and 20, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Chen et al [US 6,025,255].

Chen et al, figs 3-5 col 1-6, discloses the claimed for forming a opening in a semiconductor device comprising steps:

depositing a substantially continuous dielectric layer (28, fig 4D) upon first and second gate laterally spaced gate structures on a semiconductor layer (10) comprising isolation regions (16);

etching a first portion of the substantially continuous dielectric layer with a first etch chemistry substantially free of hydrogen (figs 4D-4E, col 5 lines 24-67 and col 6 lines 1-8) to expose a sidewall spacer of said first and second gate structures; and

etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrogen-containing compound (figs 4E-4F, col 6 lines 9-46) to expose the semiconductor layer under said substantially continuous dielectric layer.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 6-10, 12-13, 14, 18, and 19, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Flanner et al [US 5,783,496], Tsai et al [US 5,728,619], Nulty [US 5,562,801], Yang [US 6,274,481], Deboer et al [US 6,258,729], Chen et al [US 6,025,255], or Wang et al [US 6,074,959].

With respect to claims 6-10, etchants comprising substantially free of hydrogen, C_4F_8 & CO, hydrogen-containing compound, $C_2H_2F_4$ and CHF_3 are conventional etchants for etching the dielectric layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.). It would have been obvious for those skilled in the art to use etchants comprising substantially free of hydrogen or C_4F_8 /CO for etching a first portion of the dielectric layer and using etchants comprising a hydrogen-containing compound, $C_2H_2F_4$ or CHF_3 for etching a second portion of the dielectric layer in the process of Flanner et al, Tsai et al, Nulty, Yang et al, Deboer et al, Chen et al or Wang et al.

With respect to claims 12-14, 18 and 19, ranges of selectivity for the first and second etch chemistry and range of concentration of phosphorus in the dielectric layer are considered to involve routine optimization while has been held to be within the level of ordinary skill in the

art. As noted in *In re Aller*, the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

In re Aller 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmscher* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

In addition, with respect to claim 14 and 19, using a doped silicon oxide having a phosphorus concentration of less than approximately 6 Wt % as an dielectric layer is well-known in the art. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

11. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al [US ~~6,025,255~~] or Chen et al [US 6,025,255] in view of DeBoer et al [US 6,258,729].

Chen et al, figs 4's-5 and col 1-6, substantially discloses the claimed method of forming a self aligned contact comprising steps of: etching a first portion of a substantially continuous dielectric layer (28, fig 4D-4E) adjacent to a gate structure with a first etch chemistry to expose sidewall spacer (27) of said gate structure; and etching a second portion of the substantially continuous dielectric layer with a second etch chemistry comprising a hydrofluorocarbon etchant sufficiently to expose a substrate under said substantially continuous dielectric layer.

Chen et al does not teach said first etch chemistry substantially free of hydrogen.

Since it is well-known in the art that a etchant substantially free of hydrogen can be used for etching a dielectric layer, it would have been obvious for those skilled in the art to use an etch chemistry substantially free of hydrogen in the process of Chen et al to etch the first portion of the dielectric layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

In the other hand, Deboer et al teaches an equivalent between using an etch chemistry substantially free of hydrogen (fluorocarbon) or using an etch chemistry with an presence of hydrogen (hydrofluorocarbon) for etching a first portion of the dielectric layer (layer 141 of fig 4B or layer 16 of fig 1) in forming a self-aligned contact [see col 10 lines 33-48]. It would have been obvious for those skilled in the art to combine the teaching of Deboer et al in the process of Chen et al to use the first etch chemistry substantially free of hydrogen to etch the first portion of the dielectric layer – since it is well-known in the art that an etch chemistry with or without hydrogen would etch a first portion of a dielectric layer.

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Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Wang et al [US 6,183,655], Yang et al [US 6,184,147], Doshi [5,631,179], Sung et al [US 5,631,179], Ko et al [6,117,791] and Toshiharu Akimoto [JP 1-238147].

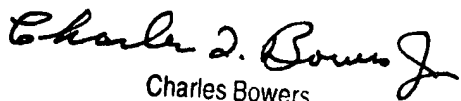
13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172.

The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bowers Charles can be reached on (703) 308-2417. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham
September 20, 2001


Charles Bowers
Supervisory Patent Examiner
Technology Center 2800